Spatial Prediction Using Combined Sources of Data

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For improved environmental decision-making, it is important to develop new models for spatial prediction that accurately characterize important spatial and temporal patterns of air pollution. As the U.S. Environmental Protection Agency (U.S. EPA) begins to use spatial prediction in the regulatory context, it will be increasingly important to combine output from atmospheric models with air monitoring data in a coherent way for improved spatial prediction, validation of model output, and development of better linkages between air quality and public health outcomes. Typically, air monitoring networks are sparsely and irregularly spaced over large spatial domains, with monitors concentrated in urban areas. Output from numerical deterministic simulation models are produced over regular grids of 36 km $\times$ 36 km or less. By taking advantage of both types of spatial information, it is possible to provide improved maps of air pollution. We present a space–time, hierarchical, Bayesian modeling approach to predict daily fine particulate levels using Community Multi-Scale Air Quality (CMAQ) output and monitoring data from the U.S. EPA fine particulate monitoring network. An assessment of improved predictive performance using this method relative to a standard spatial prediction approach is made by making predictions to sites of an independent network and calculating several goodness-of-fit statistics. This analysis is based on 2001 data in the Northeast and Midwest regions of the U.S.